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Stratal relationships of the Upper Triassic Baldonnel Formation, Williston Lake, northeastern British Columbia[1]

John-Paul Zonneveld and Michael J. Orchard
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Zonneveld, J.-P. and Orchard, M.J., 2002: Stratal relationships of the Upper Triassic Baldonnel Formation, Williston Lake, northeastern British Columbia; Geological Survey of Canada, Current Research 2002-A8, 11 p.

Abstract: The Upper Triassic (Upper Carnian to lowermost Norian, from conodonts) Baldonnel Formation outcrops extensively along the shores of Williston Lake, northeastern British Columbia. This mixed siliciclastic-carbonate unit consists primarily of calcareous to dolomitic siltstone, sandstone, and bioclastic grainstone beds. It thickens westward (basinward), as marginal marine and continental strata of the underlying Charlie Lake Formation grade laterally and vertically into shallow marine strata typical of the Baldonnel Formation.

The basal contact of the Baldonnel with the Charlie Lake Formation is characterized by an erosional unconformity at Brown Hill, but is conformable both landward (east) and basinward (west) of this locality. A dark, organic-rich, calcareous siltstone unit (Ducette Member) occurs within the medial Baldonnel Formation in western localities, but thins and pinches out eastward. The upper contact with the Pardonet Formation is conformable in the east, but characterized by an erosional unconformity in the west (basinward).

Résumé : La Formation de Baldonnel du Trias supérieur (du Carnien supérieur au Norien basal d'après les conodontes) affleure largement sur les rives du lac Williston, dans le nord-est de la Colombie-Britannique. Cette unité de roches silicoclastiques et de roches carbonatées mélangées se compose principalement de siltstone calcareux à dolomitique, de grès, ainsi que de couches de grainstone bioclastique. La Formation de Baldonnel s'épaissit en direction de l'ouest (côté bassin) alors que les strates de milieu margino-marin et de milieu continental de la Formation de Charlie Lake sous-jacente passent latéralement et verticalement aux strates déposées en milieu marin peu profond qui caractérisent la Formation de Baldonnel.

Le contact basal de la Formation de Baldonnel avec la Formation de Charlie Lake sous-jacente se présente sous la forme d'une discordance d'érosion à la colline Brown, mais est conforme tant du côté terre que du côté bassin (ouest) de cet endroit. Une unité foncée de siltstone calcareux riche en matière organique (Membre de Ducette) est présente à l'intérieur de la partie médiane de la Formation de Baldonnel dans les coupes occidentales, mais elle s'amincit au point de disparaître en direction de l'est. Le contact supérieur, avec la formation de Pardonet, est conforme à l'est, mais est représenté par une discordande d'érosion à l'ouest (côté bassin).

[1] Contribution to the Central Foreland NATMAP Project

INTRODUCTION

Upper Triassic strata in northeastern British Columbia comprise an overall deepening-upward succession of siliciclastic, carbonate, and evaporite sedimentary rocks deposited on the western margin of the North American craton. This succession is subdivided into four formations (Charlie Lake, Baldonnel, Pardonet, and Bocock; Fig. 1) and is the focus on ongoing research by Geological Survey of Canada personnel as well as scientists from several partner universities.

The Baldonnel and Pardonet formations contain the youngest carbonate hydrocarbon reservoirs in the Western Canada Sedimentary Basin (Davies, 1997). Despite the economic interest in this unit, few papers have been published on the Baldonnel Formation. Exceptions include several local field studies (i.e. Barss and Montandon, 1981; Bever, 1990), a series of preliminary wireline log correlations (Hess, 1968), and general overviews (Edwards et al., 1994; Davies, 1997). Considerable confusion remains concerning the nature of the Charlie Lake–Baldonnel and Baldonnel–Pardonet contacts, internal stratigraphic relationships within the Baldonnel Formation, and the relationship of the Ducette Member with the rest of the Baldonnel Formation. This article discusses stratal relationships of the Baldonnel Formation with adjacent and internal lithostratigraphic units.

STUDY AREA AND METHODS

This report concentrates on three outcrop sections of the Baldonnel Formation in the Peace Reach portion of Williston Lake (Fig. 2). The Peace Reach was created in 1967 by the damming of the Peace River. Prior to 1967, Upper Triassic strata in the Peace River canyon were the target of several paleontological and geological investigations (McLearn, 1930, 1940, 1941a, b). Although these outcrops (including the type locality of the Pardonet Formation) are now submerged beneath Williston Lake, new, extensive, and well exposed Triassic outcrops now occur along the lake's perimeter.

The three outcrop sections discussed in this study (East Carbon Creek, Brown Hill and Pardonet Hill) constitute an east-west (landward-basinward) transect, approximately 25 km long (Fig. 2). These sections were described by Gibson in a series of fieldguides (i.e. Gibson and Edwards, 1990, 1992), not all of which have been formally published. This article expands upon those brief descriptions as well as those in Zonneveld et al. (1997a) and Zonneveld and Gingras (2001) and provides the foundation for sequence and biostratigraphic analyses currently underway. Available conodont biostratigraphy, most of which is unpublished, is incorporated into the descriptions below and is denoted by conodont symbols on Figures 3, 4 and 5.

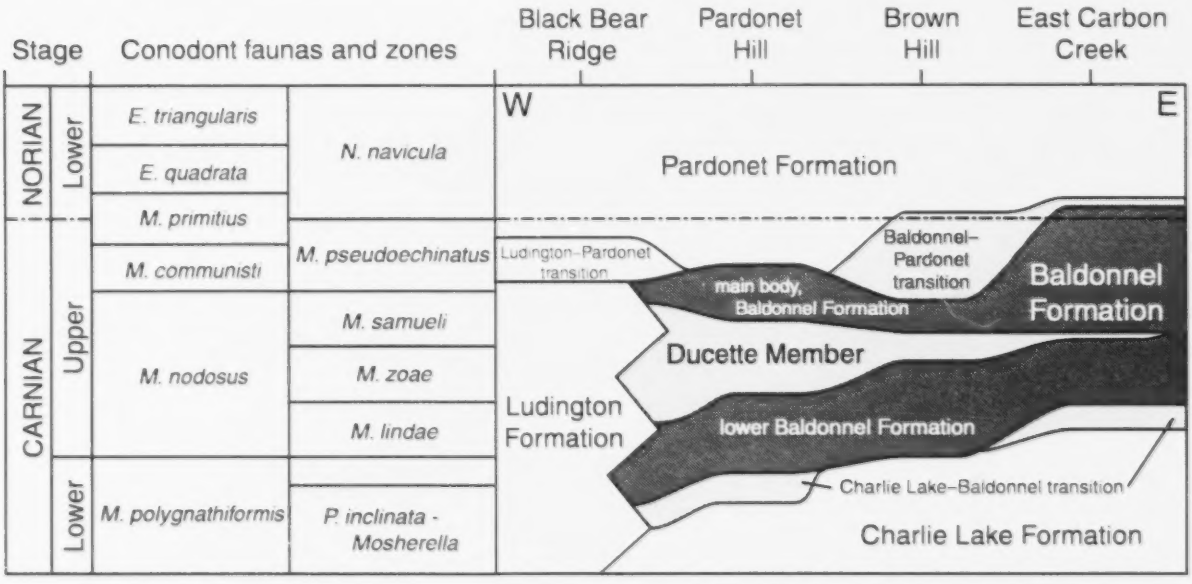

Figure 1. *Upper Triassic lithostratigraphic nomenclature and conodont biostratigraphy, Peace River outcrop belt, northeastern British Columbia. Several unconformities occur within the section; as their temporal duration is uncertain, they are not shown. Conodont biostratigraphy modified after Orchard and Tozer (1997). Data for Black Bear Ridge section from Orchard et al. (2001a, b).*

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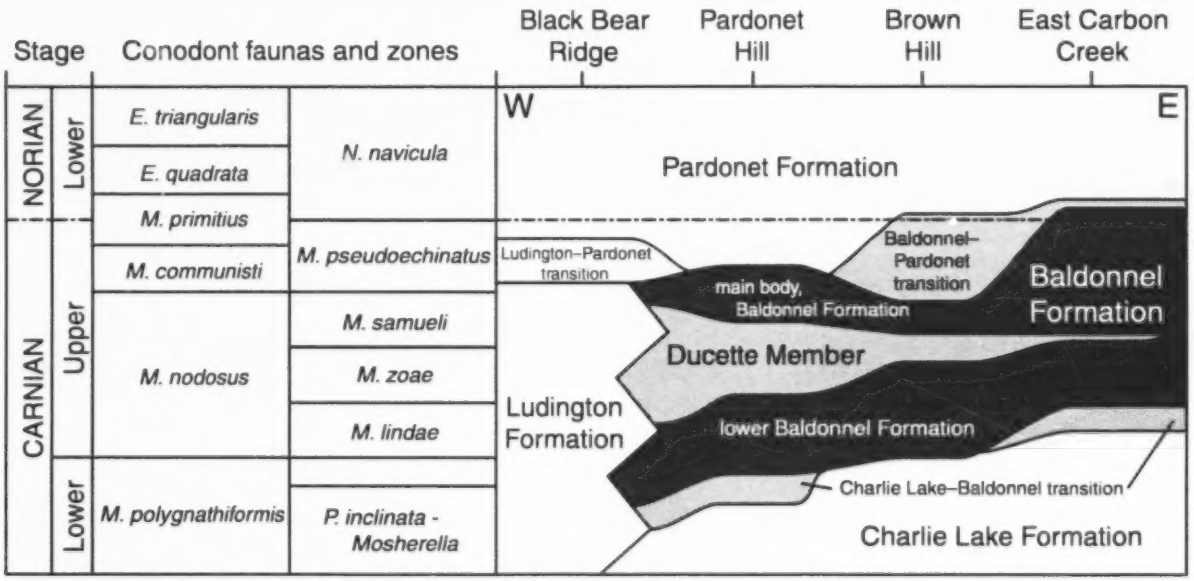

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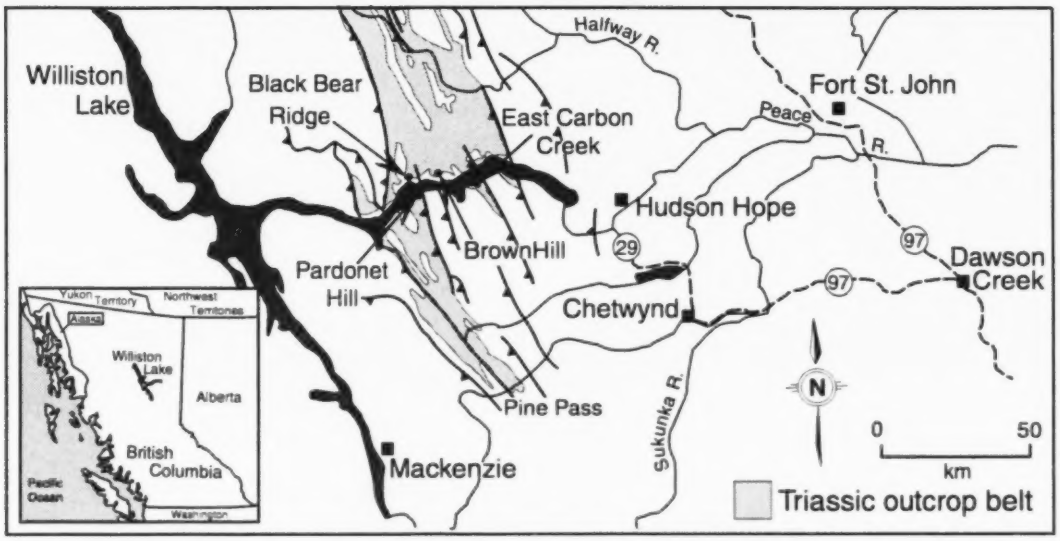


Figure 2. *Location of the outcrop sections on Williston Lake, northeastern British Columbia, discussed in this report (East Carbon Creek, Brown Hill, and Pardonet Hill). Also shown is Black Bear Ridge, discussed in Orchard et al. (2001a, b).*

Detailed stratigraphic sections were measured at each locality (Fig. 3, 4, and 5). Gamma-ray readings (emission counts per second) were obtained at 75 cm spacings through all outcrop sections using a hand-held spectrometer.

At Brown Hill and Pardonet Hill, the base of the outcrop occurs well below the study interval. Complete lithological descriptions of Triassic sections at these localities are available elsewhere (Zonneveld and Gingras, 2001). Lithological samples, thin sections, and specimens of all trace and body fossils collected have been accessioned to the collections of the Geological Survey of Canada (Calgary).

STRATIGRAPHY

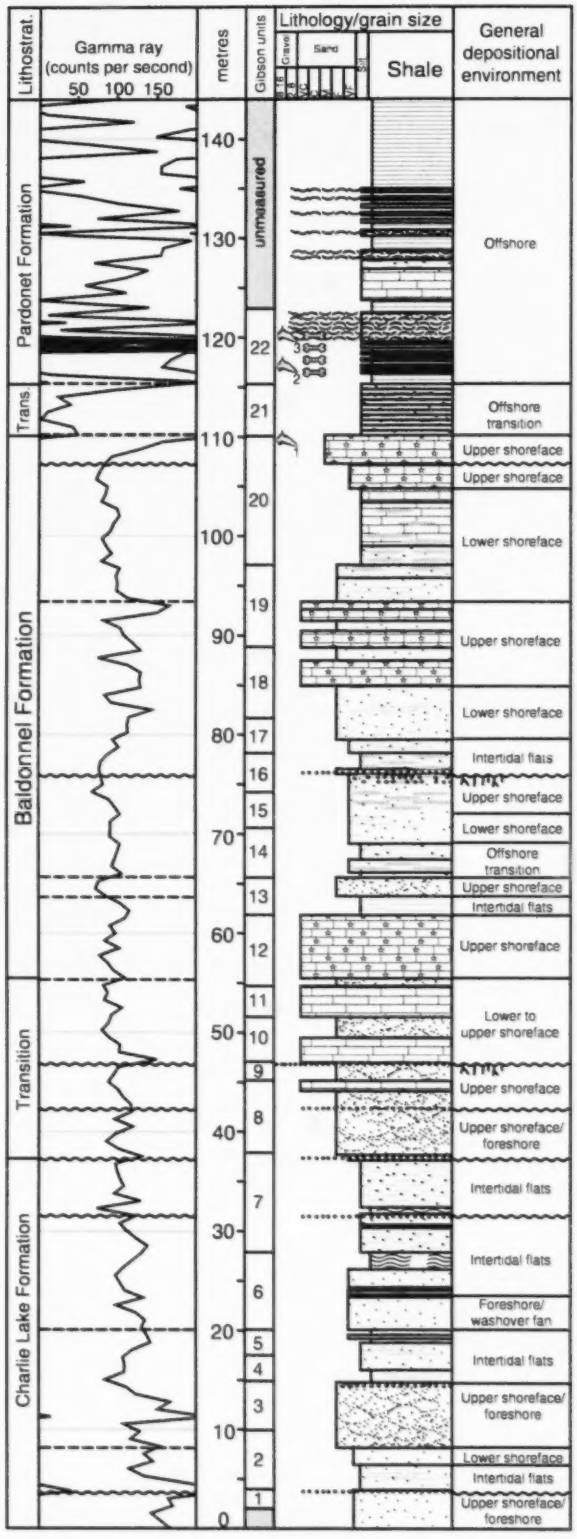
Although named by Clark (1957), the Baldonnel Formation was first formally described by Hunt and Ratcliffe (1959). The type section for the Baldonnel Formation (and the Charlie Lake Formation) was established in a well (18-84-19W6 between 1257.9 and 1297.2 m) near Charlie Lake, British Columbia (Hunt and Ratcliffe, 1959). As well as providing a broad suite of geophysical logs, this well was cored through much of the Charlie Lake and Baldonnel formations. However, in this well, the Baldonnel Formation is erosionally truncated at the sub-Jurassic unconformity, a regionally correlatable surface that progressively truncates Triassic strata eastward (Davies, 1997). Colquhoun (1962) proposed the Brown Hill section (Fig. 4) as a surface reference section for the Baldonnel Formation.

Gibson (1971) proposed the name 'Ducette Member' for a unit of recessive, dark, grey-brown-weathering, organic-rich siltstone, very fine-grained sandstone, limestone, and dolomite that occurs at the base of the Baldonnel Formation in the Rocky Mountain Foothills region between Williston Lake and the Sukunka River. In the study area, the Ducette Member occurs in the middle, rather than at the base, of the Baldonnel Formation. Strata beneath the Ducette Member are informally referred to herein as the 'lower Baldonnel' and strata above are informally referred to as the 'main body of the Baldonnel Formation'.

East Carbon Creek

Outcrop at East Carbon Creek (NTS 94 B/2; UTM 520100E, 6215900N) is the easternmost exposure, and correspondingly the thinnest occurrence, of the Baldonnel Formation in the study area (Fig. 2). The section starts in the Charlie Lake Formation and continues into the middle of the Pardonet Formation, just above the Lower–Middle Norian boundary (Fig. 3).

The position of the base of the Baldonnel is contentious in many areas (i.e. Hess, 1968; Bever, 1990; Davies, 1997). The Charlie Lake–Baldonnel contact at East Carbon Creek is no exception (Fig. 3). Gibson and Edwards (1992) placed the contact at a thin chert-pebble and phosphatic-sand lag (base of Gibson unit 10) below a dolomitic sandstone characterized by scattered crinoid ossicles (~46.9 m). We pick the basal Baldonnel contact higher in the section (55.5 m), at the base of the first thick encrinite (crinoidal grainstone). Discrepancies in identification of this contact arise from its transitional nature in many areas. At East Carbon Creek, the interval between 37 m and 55.5 m is characterized by interstratified Charlie Lake lithofacies (calcareous and dolomitic mudstone and solution collapse breccia) and Baldonnel lithofacies (cross-stratified calcareous and dolomitic sandstone and bioclastic grainstone). We identify



this interval as the Charlie Lake–Baldonnel transition and consider it to represent the onset of a local marine transgression.

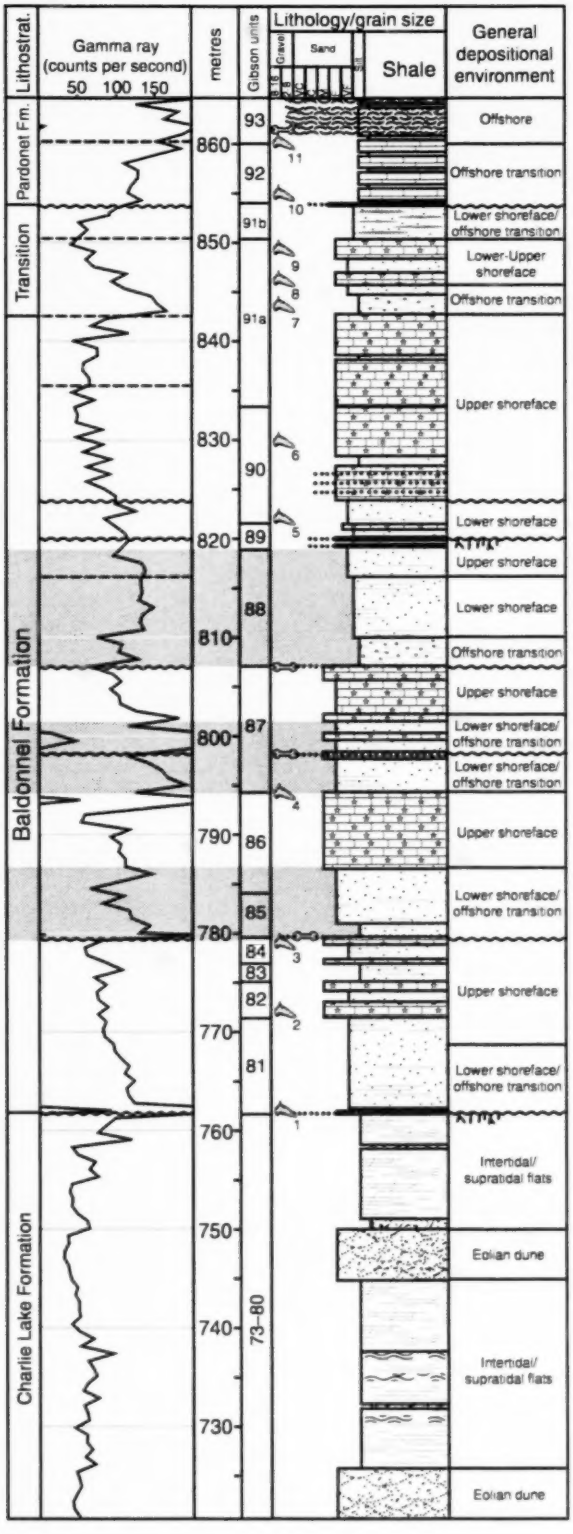
The contact picked by Gibson and Edwards (1992) is a firmground, characterized by grit-filled vertical fractures and a low-diversity *Glossifungites* assemblage, and overlain by a thin (~10 cm), poorly sorted, chert-pebble and phosphate-granule conglomerate (clasts up to 20 mm in diameter). Other levels in the transitional unit (at 31.2, 37.2, and 42.5 m) are characterized by similar lags. These lags are typically overlain by bioclastic sandstone or grainstone and are interpreted as transgressive lags.

Above the transition zone, in the basal part of the Baldonnel Formation, grain size and bed thickness gradually decrease upward (Fig. 3). Sandy encrinite beds grade upward into hummocky, cross-stratified, bioturbated, calcareous and dolomitic sandstone beds. A thin unit of wavy-bedded, dolomitic siltstone characterized by primarily horizontal trace fossils occurs between 76.9 m and 77.9 m and likely constitutes the eastern remnant of the Ducette Member (Fig. 3). Lithofacies overlying this unit gradually thicken and coarsen upward. Sandy encrinite beds are again prominent from 85 to 93 m and from 105 to 110 m. A thin package consisting of ribbon-banded dolomitic siltstone separates the Baldonnel and Pardonet formations. This facies is characteristic of neither formation and is referred to here as the 'Baldonnel–Pardonet transitional unit' (Fig. 3).

The sub-Pardonet succession at East Carbon Creek remains poorly constrained biostratigraphically, although the uppermost Baldonnel Formation is Norian, on the basis of the co-occurrence of *Metapolygnathus primitius* (Mosher) and *Norigondolella navicula* (Huckriede) (from ~109–110 m; Gibson unit 20; GSC loc. C-301193). This association is not known from the Baldonnel Formation elsewhere on the lake, where the formation is generally Late Carnian.

Poorly preserved ammonoid impressions occur in the transitional beds between the Baldonnel and Pardonet formations (110.15–115.4 m; Gibson unit 21), but they are indeterminate and the unit has not yet produced any biostratigraphically useful fossils. The ammonoids are probably Kerri Zone representatives because the basal Pardonet Formation (above the transitional beds) is characterized by a fauna similar to that from the upper Baldonnel Formation, including *M. primitius* and *N. navicula* from 115.5 to 116.4 m (base of Gibson unit 22; GSC loc. C-301194 to C-301196). These two conodont species are invariably associated with (in this case bracketing) the Kerri Zone (Orchard, 1991b).

Figure 3. *Stratigraphic section showing the vertical arrangement of lithofacies and depositional environments at East Carbon Creek. See Figure 5 for lithology patterns and symbols. VC = very coarse; C = coarse; M = medium; F = fine; VF = very fine*



Unfortunately, conodonts have yet to be recovered from the basal 115 m of the section, rendering correlations between this section and others to the west somewhat tenuous.

Brown Hill

Outcrop at Brown Hill (NTS Map 94 B/2; UTM 508000E, 6217000N), the medial of the three localities discussed in this report, is the outcrop reference section for the Baldonnel Formation (Colquhoun, 1962). The section starts in the Toad Formation and extends into the upper Pardonet Formation (lower *Monotis* beds) and provides one of the best exposed successions through the Middle and Upper Triassic in western Canada (~920 m of section). In addition to the fieldguides noted above, this locality has figured prominently in publications dealing with 1) the zonation and intercalibration of ammonoids and conodonts from the Pardonet Formation (Orchard, 1991b; Tozer, 1994); 2) the sedimentology of marginal-marine and continental strata of the Charlie Lake Formation (Arnold, 1994); 3) the sedimentology and stratigraphy of the Liard Formation (Zonneveld et al., 1997b, 2001; Zonneveld, 1999); and 4) the paleoecology of brachiopod-echinoderm biostromes from the Liard Formation (Zonneveld, in press).

The Baldonnel–Charlie Lake contact at Brown Hill is a sharp surface characterized by a low-diversity *Glossifungites* assemblage and an overlying chert and phosphatic granule lag (Fig. 4). This surface is interpreted as a transgressive surface of erosion, separating marginal marine and continental strata of the Charlie Lake Formation from overlying shoreface to offshore transition bioclastic siltstone, sandstone, packstone, and grainstone beds. The transitional succession observed at East Carbon Creek is absent at this locality.

The basal 45 m of the Baldonnel Formation consist of a series of individual coarsening-upward units that together make up an upward-fining succession (Fig. 4). The base of each individual coarsening-upward package is characterized by a lag of phosphate granules, chert pebbles, and bone debris. Strata assigned here to the Ducette Member (shale, calcareous siltstone, and very fine-grained calcareous sandstone) are interstratified with more typical Baldonnel lithofacies (fine- to medium-grained calcareous sandstone and encrinite; Fig. 4). This succession is capped by a thin erosional or hiatal surface characterized by a moderately diverse *Glossifungites* assemblage (820 m, Fig. 4).

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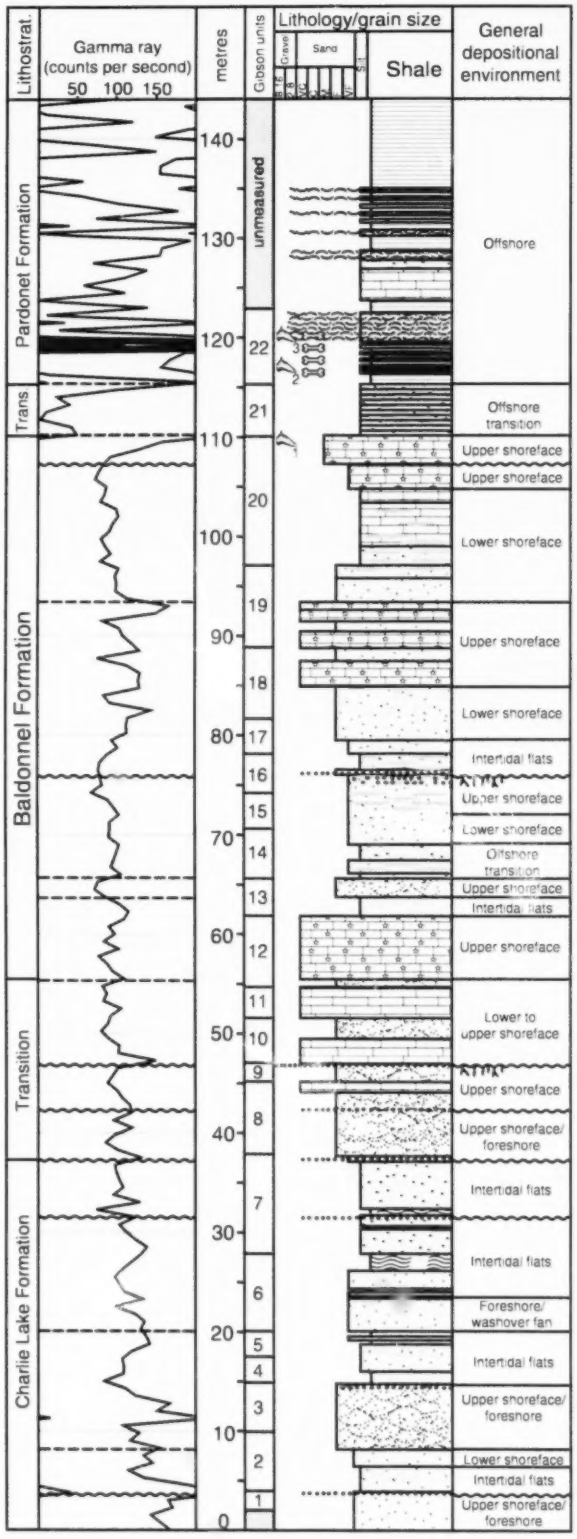

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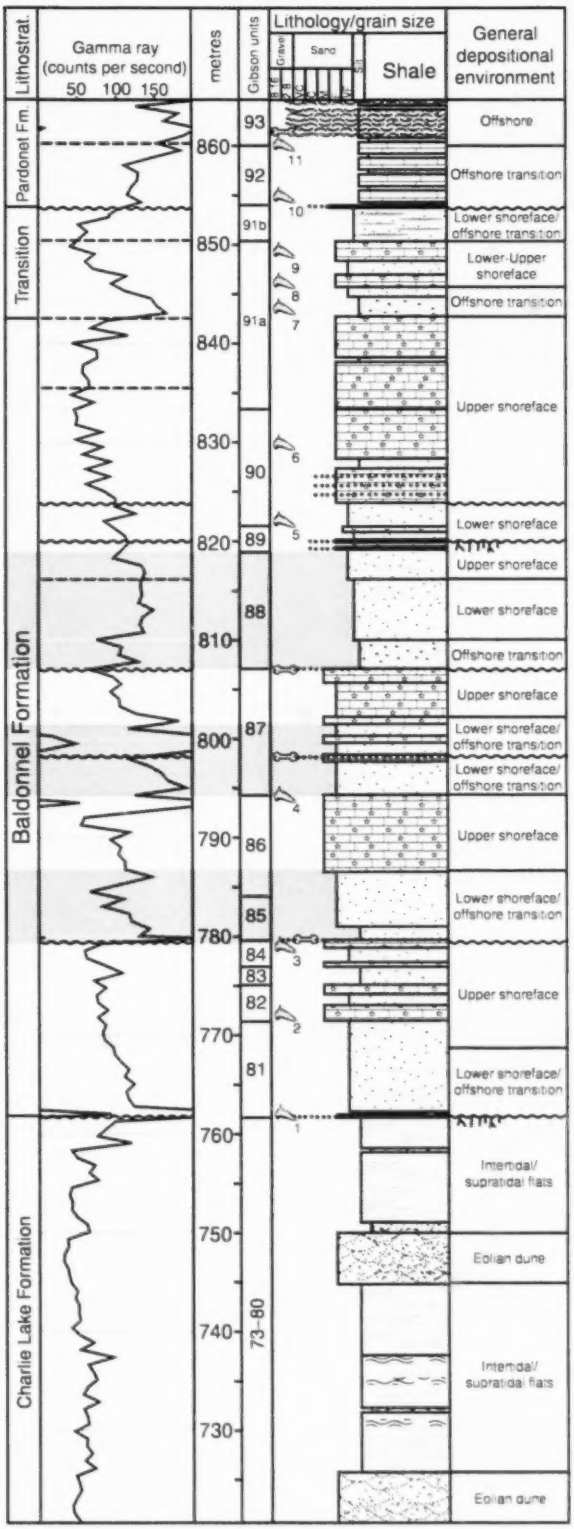

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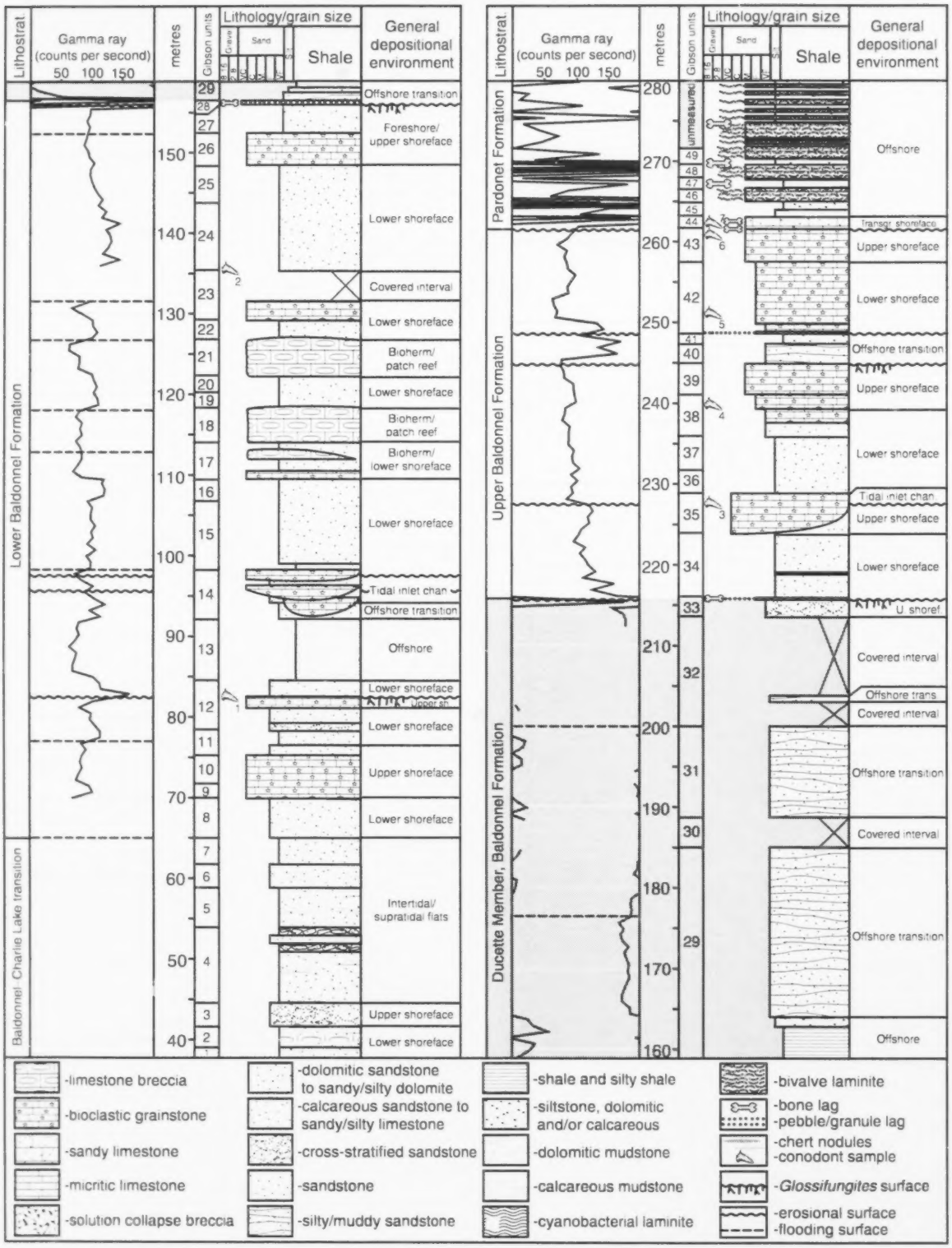

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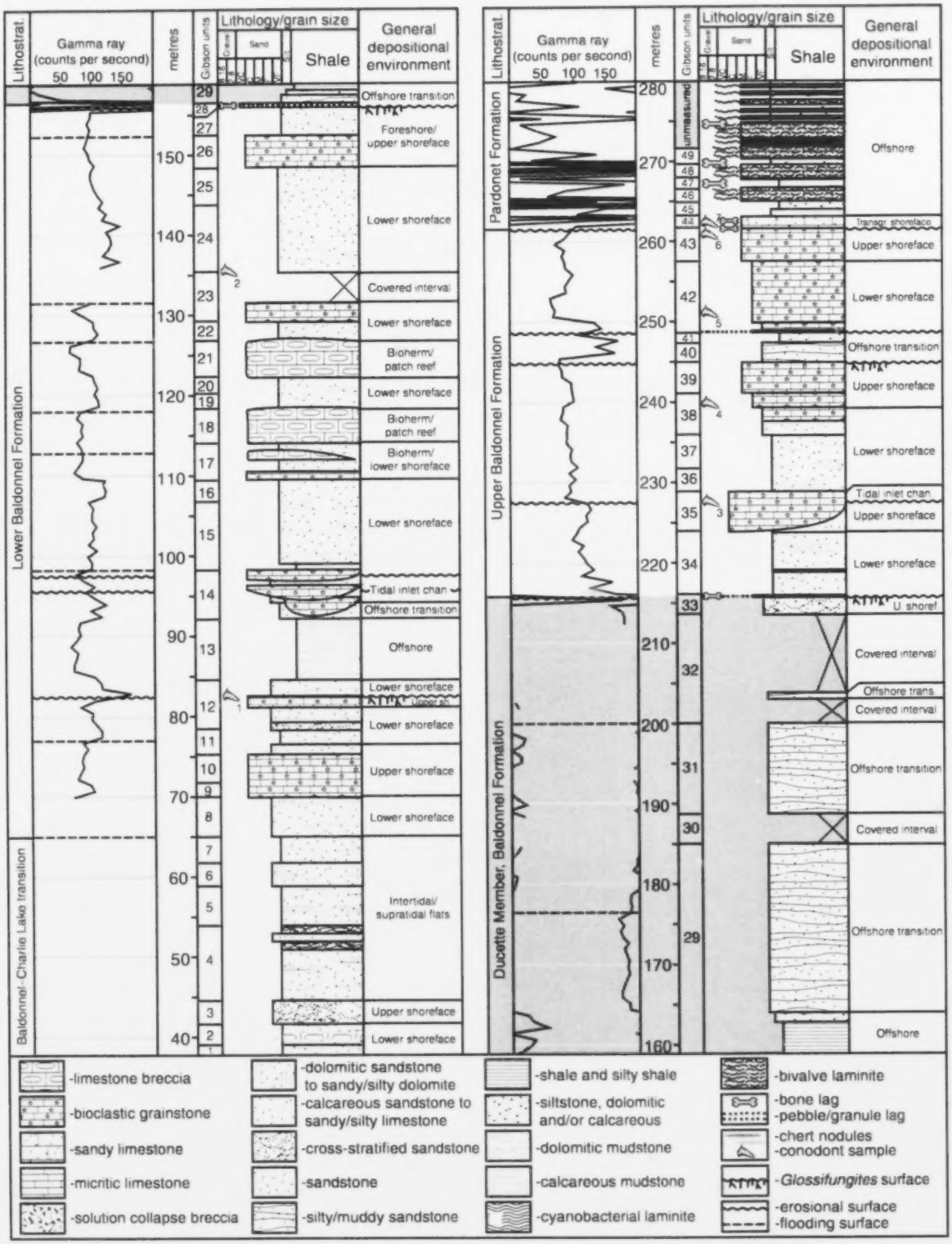

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The upper Baldonnel Formation at Brown Hill is dominated by an overall coarsening-upward succession of encrinitic beds (Fig. 4). In addition to crinoid elements, this succession contains numerous cidaroid echinoid elements, brachiopods, bivalves, and rare ammonoids. These beds are overlain by a package of interstratified limestone and siliceous siltstone that forms a transition between the Baldonnel and Pardonet formations at this locality.

The Baldonnel Formation at Brown Hill is biostratigraphically well constrained. Conodont elements assigned to *Metapolygnathus* ex gr. *nodosus* (Hayashi), including many unornamented varieties and examples of *M. lindae* Orchard, occur with shell accumulations in the transgressive lag at the base of the Baldonnel Formation (761.5 m, base of Gibson unit 81; GSC loc. C-301162). This fauna implies an age assignment very close to the base of the Upper Carnian for the base of the Baldonnel Formation at Brown Hill (Orchard, 1991a). Similar faunas occur at 771.5 m (Gibson unit 82; GSC loc. C-301163) and 777.0 m (Gibson unit 84; GSC loc. C-301164).

Conodonts recovered from the middle of the Baldonnel Formation are limited to *Metapolygnathus* ex gr. *nodosus*, indicative of a general Upper Carnian age (794 m, top of Gibson unit 86, GSC loc. C-301166; 822.5 m, base of Gibson unit 90, GSC loc. C-301170; 833 m, top of Gibson unit 90, GSC loc. C-301171). In addition to *M.* ex gr. *nodosus*, the upper Baldonnel Formation at Brown Hill contains *Metapolygnathus samueli* Orchard (846 m, GSC loc. C-201940, C-301176, C-301177, C-301179), which is the index for the upper *M. nodosus* Zone (Orchard, 1991a). Other collections from this interval are undifferentiated Upper Carnian in age (843 m and 850 m, Gibson unit 91a, GSC loc. C-201939, C-201941, C-301172 to C-301175, C-301178).

In common with East Carbon Creek, the transitional beds between the Baldonnel and Pardonet formations (850.5 to 854 m, Gibson unit 91b) have not yet produced any biostratigraphically useful fossils. The age of these beds is constrained by the Late Carnian Baldonnel Formation below, and Early Norian *Metapolygnathus primitius* and *Norigondolella navicula* above, at the base of the Pardonet Formation at Brown Hill (855 m and 859.5 m, Gibson unit 92, GSC loc. C-201943 and C-201944; 860 m, Gibson unit 93, GSC loc. C-301180).

Pardonet Hill

Pardonet Hill (NTS Map 94 B/3, UTM498650E, 6213900N) is the westernmost locality and contains the thickest Baldonnel Formation outcrop section in the study area. The section starts in the upper Charlie Lake Formation and continues (through the lower Baldonnel Formation, Ducette Member, and the main body of the Baldonnel Formation) into the lower Pardonet Formation (above which the section is disrupted and repeated by numerous faults).

As at East Carbon Creek, the Charlie Lake–Baldonnel contact at Pardonet Hill is gradational. The basal 25 m of outcrop measured at this locality consists of intercalated silty dolostone, solution collapse breccia, and bioclastic grainstone. Although the section extends below this, the basal ~35 m of outcrop occurs on an inaccessible cliff and was not measured, however, it looks similar to strata in the Charlie Lake–Baldonnel transition zone and is included in this unit. The basal contact of the Baldonnel Formation is placed at the base of the first significant (>1.0 m) encrinite (Fig. 5). The lower Baldonnel Formation is approximately 85 m thick and consists primarily of encrinite and bioclastic sandstone beds. Encrinite beds (several decimeters to 5 m thick) are commonly intercalated with calcareous sandstone.

A thinly bedded mudstone package occurs in the lower part of the Baldonnel Formation (85–93 m). Many bedding planes in this unit are characterized by scattered crinoid ossicles, articulated stem fragments, and rare whole crinoids. Unlike most fine-grained lithological units in the study area, this package is characterized by an exceptionally clean gamma-ray profile. The unit is overlain by several coarsening-upward bioclastic sandstone units containing numerous scour surfaces. These units are trough and hummocky cross-stratified sandstone beds and are populated by a moderately diverse trace-fossil assemblage dominated by vertical forms (*Diplocraterion*, *Rosselia*, *Skolithos*, and *Thalassinoides*). They are incised by erosionally based, laterally restricted (channelized), bioclastic conglomerate lenses (92–98 m; Fig. 5). These beds are overlain by intercalated bioclastic sandstone, encrinitic grainstone, and bioclastic rudstone (bioclastic breccia) beds (110–132 m; Fig. 5). These rudstone beds have flat bases, convex upper surfaces, and interfinger laterally with hummocky cross-stratified to current-ripple-laminated calcareous sandstone beds with abundant large trace fossils (*Diplocraterion*, *Rosselia*, *Skolithos*). The rudstone is characterized by crinoid debris, bivalves, gastropods, brachiopods, possibly spongiomorphs, and several varieties of scleractinian coral. Large branching corals in these beds are invariably oriented in growth position.

The channelized bioclastic conglomerate lenses and bioclastic rudstone beds in the lower Baldonnel Formation at Pardonet Hill have been interpreted previously as debris flows deposited in a deep-water slope setting (Gibson and Edwards, 1992). This interpretation is inconsistent with our field observations. Intercalation of these units with hummocky and trough cross-stratified and bioturbated calcareous sandstone beds suggests that they were deposited in a shoreface setting rather than as deep marine channels and debris flows. The rudstone beds (110–132 m) are interpreted as small patch reefs. These are the only known coral reefs on the margin of northwestern Pangea. The channelized bioclastic conglomerate units are interpreted as tidal inlet channels containing material derived at least in part from the patch reefs.

Crinoid elements are an important component of lithofacies in the Baldonnel Formation at all localities in the study area, particularly at Pardonet Hill. Encrinites are primarily a Paleozoic lithofacies, although Mesozoic examples also occur (i.e. Birkenmajer, 1977; Aigner, 1985). Regional encrinites (average thickness exceeds 5 m and areal extent exceeds 500 km^2), such as those characteristic of the

Baldonnel Formation, reflect an environment in which large parts of the shelf (or carbonate platform) were occupied by dense crinoid gardens for extended intervals (Ausich, 1997). Similar lithofacies from the German Lower Muschelkalk are interpreted as tempestites deposited landward of the pelmatozoan habitat (Aigner, 1985). Large-scale cross-stratification and an absence of associated articulated crinoids suggest that the Baldonnel Formation encrinites also accumulated landward of the crinoid meadows, likely in lower to upper shoreface settings.

Strata that we assign to the lower Baldonnel Formation at Pardonet Hill have been variously assigned to the Ducette Member (Gibson and Edwards, 1990) and to the upper Charlie Lake Formation (Gibson and Edwards, 1992). On the basis of lithological similarity to strata within the main body of the Baldonnel Formation in the same section, as well as mappable continuity with other outcrop sections on the lake, these strata are most appropriately included in the Baldonnel Formation (Fig. 6).

The Ducette Member is a major component of the Baldonnel Formation at Pardonet Hill. It forms a distinctive unit, consisting of almost 60 m of poorly exposed, highly bioturbated siltstone and silty sandstone, that separates the lower Baldonnel Formation from the main body of the Baldonnel Formation. The basal and upper contacts of the Ducette Member at Pardonet Hill are characterized by *Glossifungites*-demarcated discontinuity surfaces as well as phosphatic-pebble and bone-debris lags. Radioactive elements in this phosphatic material produce pronounced spikes in the outcrop gamma log (156.5 m and 203.5 m).

The main body of the Baldonnel Formation at Pardonet Hill is broadly similar to the lower Baldonnel Formation, but contains a greater proportion of encrinitic packstone, grainstone, and sandstone. Most of these beds are tabular. One thick (224–239 m) bed is channelized, cutting into adjacent strata. It is interpreted as a tidal inlet channel incising adjacent shoreface strata. The Baldonnel–Pardonet contact is characterized by an abrupt contact overlain by an erosional lag of chert pebbles, phosphate granules, and bioclasts. Limestone in the basal Pardonet Formation is silty, carbonaceous, and characterized by laminated bivalve hash and abundant ooids.

The Baldonnel Formation at Pardonet Hill is moderately well constrained biostratigraphically. Conodont elements assigned to *Metapolygnathus* ex gr. *nodosus* and *M. lindae* co-occur near the base of the lower Baldonnel Formation, approximately 18 m above the transitional beds between the Charlie Lake and Baldonnel formations (82.5 m, Gibson unit 12; GSC loc. C-172263). These imply the lower part of the *M. nodosus* Zone of the Upper Carnian (Orchard, 1991a). Conodonts recovered from near the top of the lower Baldonnel Formation are limited to *M. nodosus*, indicative of a general Upper Carnian age (136 m, Gibson unit 21, GSC loc. C-172265).

Lithological units within the Ducette Member have not proven conducive to conodont recovery. Conodonts recovered from the base of the main body of the Baldonnel Formation, just above the Ducette Member (228 m, Gibson unit 35, GSC loc. C-172267; 238 m, Gibson unit 38, GSC loc. C-172268) are limited to *Metapolygnathus nodosus*, a taxon characteristic of the Upper Carnian. The uppermost Baldonnel Formation (262 m, Gibson unit 43, GSC loc. C-201948) contains *Metapolygnathus communisti* Hayashi, as does the lowest Pardonet Formation, which also contains *M. nodosus* and *M. primitius*. Over the lowest 60 cm of the formation both *M. nodosus* and then *M. communisti* disappear (261.5–262.1 m, Gibson unit 44, GSC loc. C-201949 to C-201951). The occurrence of the ammonoid *Gumbelites* collected from the base of the Pardonet Formation is lowest Norian (Tozer, 1994). Therefore, the Baldonnel–Pardonet contact at Pardonet Hill is coincident with the Carnian–Norian boundary.

STRATAL RELATIONSHIPS

The Upper Triassic Baldonnel Formation reflects deposition in a mixed siliciclastic-carbonate, proximal offshore to upper shoreface (shallow shelf) setting on the western margin of the North American craton. Analysis of this unit at Williston Lake reveals that it is exceptionally heterolithic and highly diachronous (Fig. 1 and 6). In the western part of the study area, the Baldonnel Formation is separated into two informal units (lower Baldonnel Formation and main body of the Baldonnel Formation) and one formal unit (Ducette Member; Fig. 6). These three subdivisions are impossible to differentiate in the east as organic-rich silty sandstone of the Ducette Member grade into calcareous sandstone and bioclastic limestone that characterize the rest of the Baldonnel Formation (Fig. 6).

Numerous stratal surfaces characterized by evidence of erosion of subjacent sediment occur within the Baldonnel Formation. In some parts of the study area these define the upper and lower contacts of the Baldonnel Formation as well as component subunits. These surfaces are typically characterized by sharp-walled, granule-filled burrows (*Glossifungites*) and dessication cracks, as well as by chert-pebble and phosphate-granule lags. Their significance and regional extent remain unknown, but several appear correlative within the study area (a distance of ~25 km). Similar surfaces separate stratal packages in the subsurface Baldonnel Formation, commonly defining the base of individual shallowing-upward packages (Davies, 1997).

One of these surfaces (possibly a disconformity) separates the lower Baldonnel Formation from the Ducette Member at Pardonet Hill. This surface is interpreted as a transgressive surface of erosion, and may be correlative with the erosional surfaces that occur at the base of the Baldonnel Formation at Brown Hill and at the base of the Charlie Lake–Baldonnel transitional interval at East Carbon Creek (Fig. 6).

A similar surface occurs at the top of the Baldonnel at Pardonet Hill, between the Baldonnel Formation and the Baldonnel–Pardonet transitional unit at Brown Hill and within the upper Baldonnel Formation at East Carbon Creek (Fig. 6). This surface is approximately coincident with the

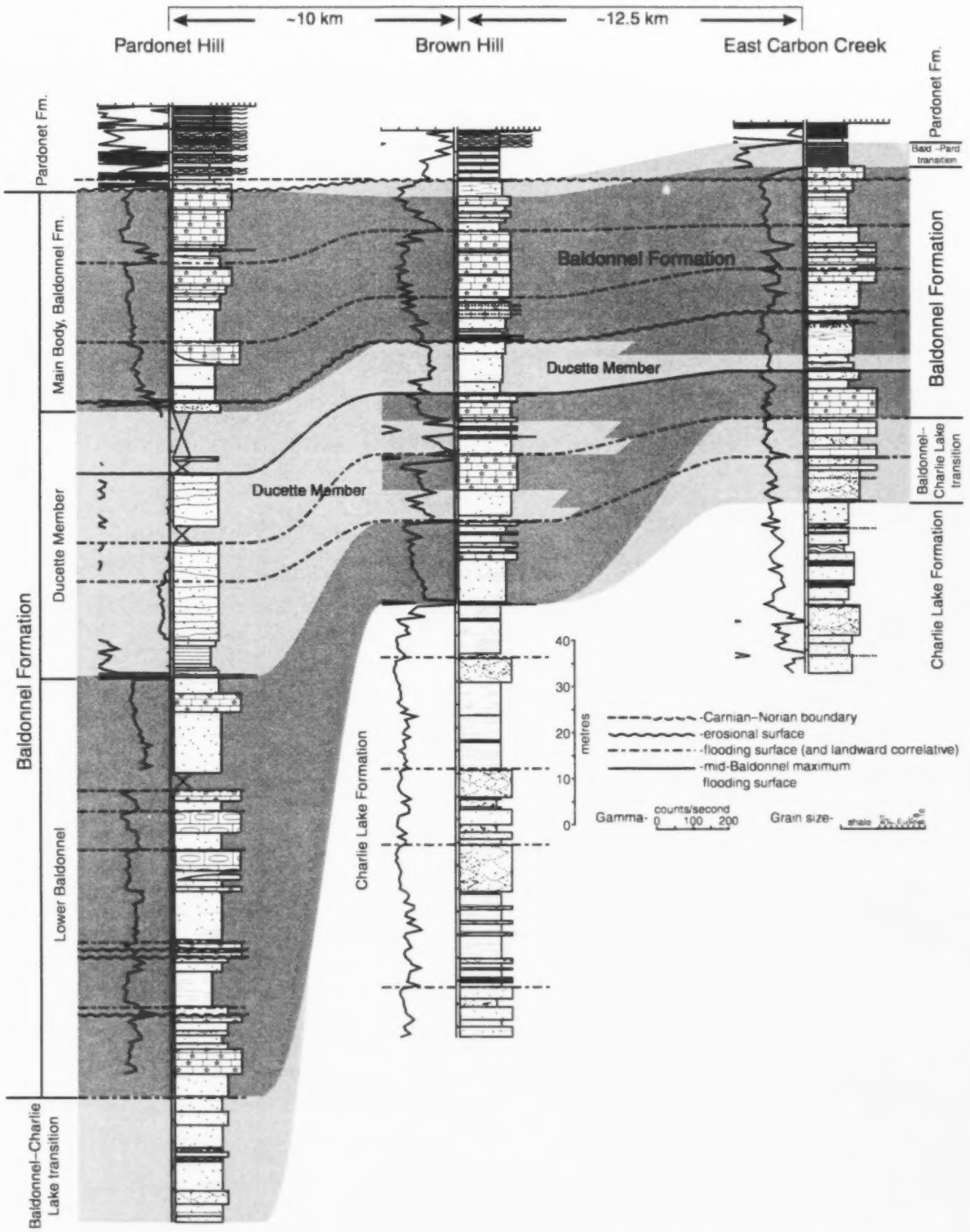

Figure 6. *Preliminary correlation of stratigraphic sections. Location of sections shown in Figure 2.* See *Figure 5 for lithology patterns and symbols.*

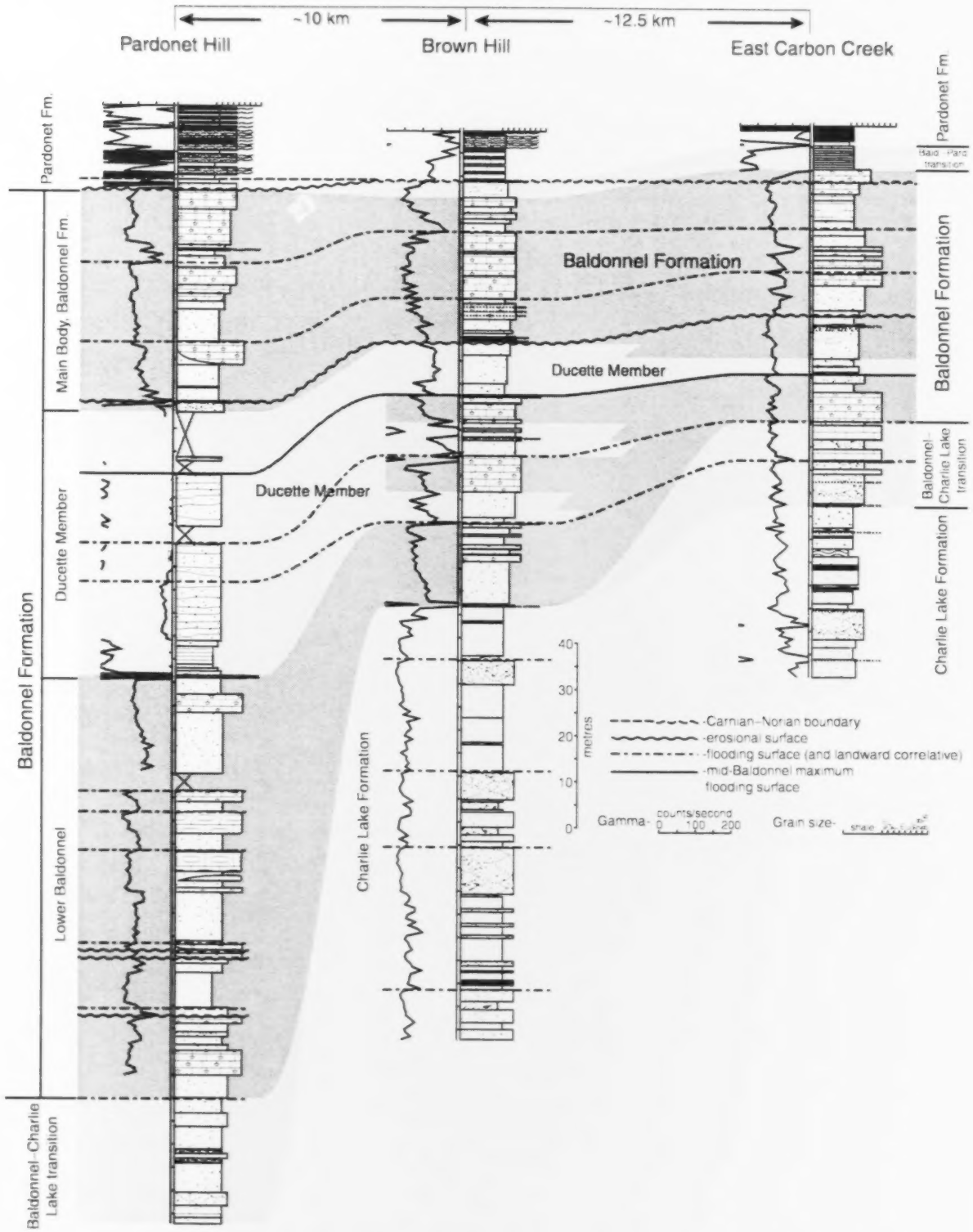

Figure 6. *Preliminary correlation of stratigraphic sections. Location of sections shown in Figure 2.* See *Figure 5 for lithology patterns and symbols.*

Carnian–Norian boundary. It may be a coplanar lowstand surface of erosion and transgressive surface of erosion equivalent to the globally correlatable Carnian–Norian sequence boundary discussed by Embry (1997).

It is anticipated that with close analysis of adjacent stratigraphic units and description of additional outcrop sections in the study area, a detailed and accurate sequence stratigraphic model for the Upper Triassic in the Williston Lake region will evolve. Additional biostratigraphic data are crucial to ensure the veracity of correlations and to accurately place the study interval into a regional and global stratigraphic context.

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